English Translation

# PATENT ABSTRACTS OF JAPAN

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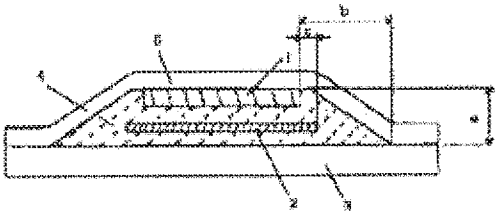
## (54) SOLAR CELL MODULE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide good scratch resistance and to reduce the thickness and weight by embedding a step level difference of peripheral edge of a solar cell and a surface of a module base member with an adhesive to smooth them, and then forming a coating material.
SOLUTION: An amorphous silicon solar cell 1 is formed on a stainless steel substrate having a thickness of 125 mm. Adherences of the cell 1 to an insulating sheet material 2 made of a nylon film having a thickness of 50 μm and the material 2 to a metal plate 3 are conducted by using an EVA resin 4 having a thickness of 300 μm. The resin of the adhesive is extended from a peripheral edge of an overall peripheral edge of the cell 1 to the outside so that upper and lower EVA resins are integrated, and a coating material is formed on the overall surface of a module. Accordingly, a thick film can be formed of paint material similar to other portion. Thus, the solar cell module for realizing a thin layer of a surface protective material can be provided.



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## CLAIMS

[Claim(s)]
[Claim 1]A solar battery element which forms a photoelectric conversion semiconductor layer on a module base substance component, the 1st adhesives, and a substrate laminates one by one, and is arranged, A solar cell module which the surface is a solar cell module which it comes to cover with covering material, and is characterized by forming said covering material throughout the solar cell module surface after filling up a level difference of a periphery of said solar battery element, and said module base substance member surface with said 1st adhesives and making it gently-sloping.
[Claim 2]A module base substance component, the 1st adhesives (or the 2nd adhesives), an insulating sheet material, A solar battery element which forms a photoelectric conversion semiconductor layer on the 2nd adhesives (or the 1st adhesives) and a substrate laminates one by one, and arranges, A solar cell module which the surface is a solar cell module which it comes to cover with covering material, and is characterized by forming said covering material throughout the solar cell module surface after filling up a level difference of a periphery of said solar battery element, and said base substance member surface with said 1st adhesives and making it gently-sloping.
[Claim 3]The solar cell module according to claim 1 or 2 hardening said 1st adhesives where thrust is applied near [ said ] the solar battery element peripheral edge part.
[Claim 4]A solar cell module given in any 1 clause of Claims 1-3, wherein said 1st adhesives are liquid glue which has the viscosity of 100 or more cp at the time of un-hardening, or a solid adhesive.
[Claim 5]A solar cell module given in any 1 clause of Claims 1-4 processing the surface of said 1st adhesives by a coupling agent of an organic compound.
[Claim 6]A solar cell module given in any 1 clause of Claims 1-5 adding a coupling agent of an organic compound in said covering material.

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## DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to a solar cell module. It is related with the solar cell module which realizes lamination of the covering material of a solar battery element in details more.
[0002]
[Description of the Prior Art]The solar cell which is an optoelectric transducer which changes sunlight into electrical energy is widely used as a power supply for household equipments, such as a calculator and a wrist watch, and attracts attention as technology utilizable as the so-called electric power for substitution of fossil fuels, such as petroleum and coal.
[0003]It is the technology using the diffusion potential generated in the pn junction part of a semiconductor, and semiconductors, such as silicon, absorb sunlight, an electron and the optical carrier of an electron hole generate a solar cell, and it carries out the drift of this optical carrier by the internal field produced with the diffusion potential of the pn junction part, and is taken out outside. As a material of a solar cell, single crystal silicon, polycrystalline silicon, an amorphous silicon, The compound semiconductor of III-V fellows, such as II-VI groups, such as an amorphous semiconductor of tetra HEDORARU systems, such as amorphous silicon germanium and amorphous SiC, CdS, $Cu_2S$, GaAs, GaAlAs, etc. are raised. The thin film solar cell using an amorphous semiconductor has the strong points, like that thickness is thin and ends and it can deposit [ that the film of a large area is producible as compared with a single crystal solar cell, and ] on arbitrary substrate materials, and promising ** is especially carried out.
[0004]By using the solar battery element of the thin film made on the existing substrate of the flexibility of stainless steel etc., an amorphous-silicon solar cell, a crystalline thin film solar cell, etc. are thin, are light, and are further made from the form of the existing flexible solar cell module, and practical use is presented with them. The surface is covered with covering material for protection from weatherability and a mechanical damage.
[0005]As a valuation basis of the covering material of a solar battery element, the "scratch test" of UL described below occurs, and if this examination can be passed, the protection ability of that covering material is considered to be sufficient thing.
[0006]If the solar cell surface is moved and there is no problem in the electrical performance of a subsequent solar cell, adding 907 g of load 8 for a testing machine with the edge 7 made of steel shown in drawing 4 by speed 152.4 mm/s when the contents of the "scratch test" are described briefly, it will be considered as success.
[0007]Incidentally, as a protective material of a solar battery element, EVA (ethylene vinyl acetate) resin and a fluoro resin film are usually used. However, in order to make EVA distribute glass fiber and for the thickness to be not less than 450 micrometers, in order to demonstrate coating protection capability with a sufficient solar battery element, and to form an about 50-micrometer fluoro resin film on it, there is a problem that a protective material will be a thick film.

[0008]On the other hand, the demand of lamination and a weight saving is stronger than that of a solar cell, and it is required that the covering material of a solar battery element should be made as thin as possible.
[0009]The methods include the method of covering a solar battery element by coating the solar battery element surface with paint material, for example. With reference to drawing 2, an example of the amorphous-silicon solar cell module produced using the coating method of the solar battery element by this coating method is explained.
[0010]The metal electrode layer which 1 is a solar battery element and was formed by methods, such as sputtering, on the 125-micrometer-thick stainless steel board in drawing 2, The amorphous silicon semiconductor layer which formed n, i, and p layer one by one with plasma CVD method etc., and the transparent electrode layer formed with resistance heating vacuum deposition etc. are laminated in order, and it is formed. 2 is an insulating sheet material and consists of 50-micrometer-thick Nylon etc. 3 is a metal plate used as the module base substance component of a solar cell module, and a 300-micrometer-thick zinc coated steel sheet etc. are used. 4 is adhesives, adhesion with the solar battery element 1, the insulating sheet material 2 and the insulating sheet material 2, and the metal plate 3 is performed, respectively, and EVA is used, for example. Here, about the solar battery element 1, the current collection electrode which used silver paste etc. with screen printing and was formed on the transparent electrode layer is connected to an unillustrated external positive pole terminal, and the stainless steel board is connected to the unillustrated external negative pole terminal.
[0011]In order to carry out coating protection of such a solar battery element 1, a fluorocarbon resin coating is used, for example and the about 150-micrometer covering material 5 is formed in thickness. As performance as which this covering material 5 is required, can consider the dampproofing for protecting the solar battery element surface from moisture, the hard nature for passing a "scratch test", weatherability, etc., and as the material, An inorganic coating material, a fluorocarbon resin coating, acrylic silicon paints, or these things that were combined are used. Thus, the lamination of covering material is attained by constituting covering material with said paint material.
[0012]However, when a solar cell is covered only with the covering material 5, in the A section which is an end of a stainless steel board, there is a problem that it is difficult to form sufficient coated state which can pass the "scratch test" mentioned above. because, the thickness of the stainless steel board whose thickness of the covering material 5 is about 150 micrometers and which it is alike, it receives and is a base substance of a solar battery element 125 micrometers, The thickness of a solar battery element and the adhesives layer for adhesion of an insulating sheet material 100 micrometers, As the thickness of the adhesives layer for adhesion of 50 micrometers, an insulating sheet material, and a metal plate of the thickness of an insulating sheet material is 100 micrometers, the level difference B of the solar battery element surface and a metal plate is set to about 375 micrometers and it is shown in drawing 2, It is because paint material cannot flow at the time of un-hardening and about at most 30 micrometers of thickness C of the covering material 5 of the A section cannot be formed.
[0013]Therefore, in the solar cell peripheral edge part which is equivalent to the A section of drawing 2, covering will fracture easily with the edge 7 made of steel so that drawing 5 may show. That is, hard nature becomes low and a "scratch test" cannot be passed. Then, like the A section, as compared with the thickness of covering material, a level difference is large, and into the portion in which encased type voice sufficient by just covering of paint material is not formed, as shown in drawing 3, a stepped section is buried by forming the overcoat material 6, such as silicon resin, and into it, the composition which forms covering material on it can be considered.
[0014]However, in the process of providing such overcoat material, After applying overcoat material using coaters, such as a dispenser, it is necessary to stiffen overcoat material by heating or UV irradiation, and to carry out spreading hardening of the paint material on it, and the application

process and curing process of overcoat material are required. For this reason, the time and the worker who manufacturing systems, such as a coater, a heating furnace, or a black light, are needed, and newly require for this process are needed, and there is a problem that the manufacturing cost of a solar cell module will rise substantially for formation of overcoat material.
[0015]
[Problem to be solved by the invention]In view of the above-mentioned fault, the 1st technical problem of this invention, In the solar cell module which installs a solar battery element on a module base substance component, and forms covering material in the surface, while scratch-proof nature is good and provides a thin light solar cell module, it is simplifying a process and reducing cost.
[0016]
[Means for solving problem]The solar cell module of this invention A module base substance component, the 1st adhesives, The solar battery element which forms a photoelectric conversion semiconductor layer on a substrate laminates one by one, and is arranged, After having been a solar cell module which it comes to cover with covering material in the surface, filling up the level difference of the periphery of said solar battery element, and said module base substance member surface with said 1st adhesives and making it gently-sloping, said covering material was formed throughout the solar cell module surface.
[0017]Other solar cell modules of this invention A module base substance component, the 1st adhesives (or the 2nd adhesives), The solar battery element which forms a photoelectric conversion semiconductor layer on an insulating sheet material, the 2nd adhesives (or the 1st adhesives), and a substrate laminates one by one, and is arranged, The solar cell module which the surface is a solar cell module which it comes to cover with covering material, and is characterized by forming said covering material throughout the solar cell module surface after filling up the level difference of the periphery of said solar battery element, and said base substance member surface with said 1st adhesives and making it gently-sloping.
[0018]As for said 1st adhesives, it is preferred to harden, where thrust is applied near [ said ] the solar battery element peripheral edge part. As for said 1st adhesives, it is desirable that they are the liquid glue which has the viscosity of 100 or more cp at the time of un-hardening, or a solid adhesive. It is desirable for the surface of said 1st adhesives to process by the coupling agent of an organic compound, or to add the coupling agent of an organic compound in said covering material.
[0019]
[Mode for carrying out the invention]Next, an embodiment of the invention is described.
[0020]Since a solar battery element peripheral edge part is filled up with the 1st adhesives and is gently-sloping as the solar cell module of this invention is shown in drawing 1, covering of the covering material of a solar cell is uniformly performed to the whole solar battery element. Therefore, it becomes possible to prevent the fracture of the covering material by a scratch test. Since a level difference is buried with the 1st adhesives, it can manufacture by the same manufacturing process as the former, and the increase in a manufacturing cost can be prevented.
[0021]The production procedures of the solar cell module of this invention are shown below.
[0022]First, arrangement adhesion of the solar battery element is carried out via the 1st adhesives on a module base substance component. Or it arranges on a module base substance component in order of the 1st adhesives, an insulating sheet material, the 2nd adhesives, and a solar battery element. Here, the 1st adhesives at least protrude and form the periphery of a solar battery element. Reverse may be sufficient as the built-up sequence of the 1st adhesives and the 2nd adhesives, and it may use the same adhesives.
[0023]The 1st and 2nd adhesives use for and apply a dispenser apparatus, a die coater device, etc. to an adhesion side, or arrange sheet shaped adhesives between adherends, are heated, for example and are made to harden them, where thrust is applied near the solar battery element peripheral edge part at least. Specifically, the method using the vacuum laminator device mentioned later is suitable one of the methods.

[0024]Next, covering material is formed in the solar cell module produced in this way. In order to realize the lamination, paint material is preferred and the formation method applies to the formation method of the paint material used, respectively correspondingly, but. For example, two coats is performed several times and it is made to harden at about 120 ** so that it may become a film uniform on the module surface with air spray equipment etc. about a liquefied paint material.
[0025]When providing two or more solar battery elements, series parallel connection is made to complete before adhesion in this invention. Positive [ modular ] and the external terminal of an anode make a hole in the component used as the base substance of said module, and the method of taking out from the rear-face side is suitable for the solar cell module of this invention.
[0026]The solar cell module of this invention is produced by a process which was described above.
[0027]In the solar cell module of this invention, it is preferred at the time of hardening of said adhesives to change into the state where thrust was applied via the component with [ near the solar battery element peripheral edge part ] elasticity at least of a solar battery element and a module base substance component. Said adhesives can be formed in desired form by applying thrust via a component with elasticity. As construction material of a component with elasticity, the thing of quality of a rubber material, such as silicone rubber and neoprene rubber, is used, for example.
[0028]Although the 1st adhesives are protruded outside a solar battery element peripheral edge part and formed at least in this invention, In order that the formation range of adhesives may bury the stepped section on the surface of a solar cell module and may form adhesives with desired sectional shape, It is preferred to set distance from a and the periphery of a solar battery element to an adhesives end to b for the height from the surface of a module base substance component to the solar battery element surface, and to fill b>=1.5a, as shown in drawing 1.
[0029]As adhesives, adhesives, such as hot melt adhesive, such as elastomeric adhesives, such as adhesives of an epoxy resin system, an acrylic resin system, a polyurethane resin system, and a silicon system and a polychloroprene system, an EVA resin system, and a polyamide resin system, are suitably used by this invention, for example.
[0030]The liquid glue or the solid adhesive of 100 or more cp has [ the 1st adhesives at least ] viscosity preferred when thrust, such as atmospheric pressure, is added at the time of the curing process of adhesives at the time of un-hardening so that desired form can be formed without adhesives flowing out.
[0031]As covering material of the solar cell module of this invention, In order to realize lamination of covering material, what it was preferred that it is paint material, and a material excellent in weatherability, dampproofing, hard nature, etc. was used, for example, these paint material, such as an inorganic coating material, a fluorocarbon resin coating, and an acrylic silicon paint, combined is used suitably.
[0032]For the improvement in adhesion of the surface of said adhesives and covering material, the coupling agent of an organic compound is added in said covering material, Or it is preferred to process said adhesives surface by the coupling agent of an organic compound, and a silane coupling agent, a titanate coupling agent, etc. are raised as the material, for example.
[0033]As a module base substance component of the solar cell module of this invention, metal, the metal which performed the insulation process to the rear face, a carbon fiber, glass fiber reinforced plastic, ceramics, glass, etc. are used, for example.
[0034]As for the size of a module base substance component, it is desirable to have an outside large not less than 2 mm in all the directions in consideration of the formation range of the adhesives mentioned above from the outermost form peripheral edge part of one solar battery element or two or more solar battery elements which were connected.
[0035]As an insulating sheet material of this invention, PET (polyethylene rente phthalate), PEN (polyethylenenaphthalate), nylon, polypropylene, a fluoro-resin, etc. are used, for example.
[0036]As for the size of an insulating sheet material, since the end disturbs and is not formed from adhesives, it is preferred that the distance c from the periphery of a solar battery element to the

end is within the limits of 0 <=c<=0.5a.
[0037]
[Working example]Although an working example is given to below and this invention is explained more to it at details, it cannot be overemphasized that this invention is not limited to these working examples.
[0038](Working example 1) Drawing 1 is a sectional view showing the working example 1 of the solar cell module of this invention.
[0039]In the working example 1, the amorphous-silicon solar cell element 1 was formed on the 125-micrometer-thick stainless steel board. Both thickness of both performed adhesion with the solar battery element 1 and the 50-micrometer-thick insulating sheet material 2 made from a nylon film, and adhesion with the insulating sheet material 2 and the metal plate 3 (300-micrometer-thick module base substance component made from a zinc coated steel sheet) using the EVA resin 4 which is 300 micrometers. And EVA resin which is adhesives crossed throughout the peripheral edge part of the solar battery element 1, and overflowed outside the peripheral edge part, and up-and-down EVA resin was united, and formed covering material over the module surface top whole region on it.
[0040]In the working example 1, the adhesion method of the solar battery element 1, the insulating sheet material 2, and the metal plate 3 is explained below.
[0041] The EVA resin used in working example 1 is formed in a 300-micrometer-thick sheet shaped. This EVA resin sheet was greatly cut 5 mm in all the directions from the outside of the insulating sheet material 2, it carried on the metal plate 3, and the insulating sheet material 2 was carried on it. At this time, the outside of the metal plate 3 was larger in all the directions 20 mm than in the insulating sheet material 2, and the insulating sheet material 2 was produced greatly 1 mm in a similar manner than the solar battery element 1. Similarly, the EVA resin sheet was cut more greatly [ it is the same and ] 3 mm than the outside of the solar battery element 1, it carried on the insulating sheet material 2, and the solar battery element 1 was carried on it.
[0042]There are more sizes of an EVA resin sheet in proper quantity from the point of adhesive strength as a quantity of adhesives. However, it can form in the form of the request which fills above-mentioned b>=1.5a with stiffening thrust by ********** to a solar battery element peripheral edge part with the adhesives beyond this proper quantity.
[0043]Next, the field which has not performed easily-adhesive processing of corona discharge treatment etc. for the 50-micrometer-thick fluoro resin film 9 with a larger outside dimension than the metal plate 3 as a mold releasing film was turned down, and was carried. Next, this was installed in the above-mentioned vacuum laminator device 10 shown in drawing 6.
[0044]The pipe 12 is formed in the wall surface 11, and the vacuum laminator device 10 is connected to the vacuum pump in which this pipe 12 is not illustrated. The heater 14 is arranged under the copper plate 13, and it can be set as a desired temperature. 15 is flexible sheets, such as silicone rubber, and has elasticity. A vacuum pump can be used and the inside of equipment can be airtightly closed by the sealant 16. In this state, after holding the inside of equipment for 30 minutes at 150 ** with the heater 14, it cooled to the room temperature with unillustrated cooling-water-flow equipment.
[0045][0045]. It is bridge construction anti-****** about EVA resin to have inside of equipment for 30 minutes at 150 ** in 150 **.
It is a sake, and in this state, since it would be pressed down with atmospheric pressure via the flexible sheet 15 by softening EVA resin and making the inside of equipment into a vacua, as it mentioned above, EVA resin overflows a solar battery element peripheral edge part and an insulating sheet material, and it is **.
As a result, as shown in drawing 1, the form which the surface buries the level difference of the periphery of a solar battery element and a metal plate surface, and makes gently-sloping is formed.
[0046]Although EVA resin is pressed down by atmospheric pressure as viscosity is dramatically low,

and it flows at 150 ** at this time and it becomes impossible to form in the above form, The EVA resin adopted as the working example 1 had suitable viscosity (100,000 cp), was able to bury the level difference and was able to make it gently-sloping form.
[0047]Next, the process of forming covering material in the solar cell module produced as mentioned above is explained briefly.
[0048]An about 150-micrometer enveloping layer was formed by carrying out by two coats several times, and carrying out neglect hardening of the fluoro-resin system paint for 40 minutes at 120 ** all over a heating furnace with air spray equipment, throughout the surface of a solar cell module.
[0049]At this time, as mentioned above, in a solar battery element peripheral edge part, the solar cell module of the working example 1 EVA resin, Since it was formed in the form which makes gently-sloping the level difference of the periphery of a solar battery element, and a metal plate surface, in the solar battery element peripheral edge part which is a problem of a conventional example, covering material did not necessarily become thin and covering material was formed by uniform thickness.
[0050][0050]. As for the paint of this fluoro-resin system, ******** passes an above-mentioned scratch test.
Electrical property change of appearance change of covering material are a thing and according to a scratch test, photoelectric conversion efficiency, etc. is a private seal.

[0051]As mentioned above, since the produced solar cell module did not newly provide overcoat material in a solar battery element peripheral edge part as conventional technology described, it has realized lamination of the covering material of a solar cell module, without being accompanied by the process time and the cost hike concerning this process.
[0052]The (working example 2), next the working example 2 of this invention are shown in drawing 7.

[0053]The solar battery element 1 was produced like the working example 1, and used the glass fiber strengthening polyester resin board 17 which is an insulating substrate as a module base substance component. The solar battery element 1 and the glass fiber strengthening polyester resin board 17 were pasted up using the 1 liquid heat cure type adhesives (Yokohama Rubber Co., Ltd. make Y-3800) 18 of an epoxy resin system.
[0054]Since the viscosity at the time of un-hardening also had 500p, adhesives (Y-3800) were applied with the die coater device. It was larger in all the directions 2 mm than in the outside of the solar battery element 1, and applied to about 100 micrometers in thickness, and on it, still like the working example 1, the fluoro resin film 9 was carried and the solar battery element 1 was installed in the vacuum laminator device 10 at the glass fiber strengthening polyester resin board 17 top.
[0055]It determined having made this adhesive application range into the above-mentioned value based on the result obtained by experiment so that the formation range of adhesives might be formed in the form of the request which fills b>=1.5a like the working example 1.
[0056]In the working example 2, although adhesives were applied to the large glass fiber strengthening polyester resin board 17 of an outside as adherend, Conversely, it applies to the solar battery element 1, and a part insufficient in the desired amount of adhesive applications may use a dispenser apparatus etc. for a solar battery element peripheral edge part, and may perform the method of forming separately.
[0057]Next, it installed in the vacuum laminator device 10, the inside was made into the vacua, and it held at back 120 ** for 10 minutes. The solar cell module was taken out after cooling. Although the curing conditions of adhesives (Y-3800) were 40 minutes at 120 **, the adhesives Y-3800 were formed in the form which makes gently-sloping the level difference of the periphery of a solar battery element, and a glass fiber strengthening polyester resin sheet surface like the working example 1 of the above-mentioned heating conditions.The surface of adhesives (Y-3800) was already hardened, and it was able to remove the fluoro resin film which is said mold releasing film,

without breaking down the form of adhesives.
[0058]In this process, it was able to form in desired form without having pushed the viscosity of the adhesives Y-3800 on atmospheric pressure like the working example 1 by 500p and a dramatically high thing and flowing.
[0059]The process of forming a surface coating member was performed like the working example 1. In order to stiffen paint material, it put into a 120 ** heating furnace for 40 minutes first in 30 minutes and in the back. By this heating condition, adhesives (Y-3800) were able to be stiffened thoroughly.
[0060]When the scratch test of the solar cell module produced as mentioned above was done, appearance change of the covering material by examination and change of the electrical property were not accepted.
[0061](An working example 3), next an working example 3 of this invention are described. Drawing 8 and drawing 9 are a top view of an working example 3, and a sectional view in D-D, respectively. In an working example 3, the series connection of the three solar battery elements is carried out to the metal plate 3 of one sheet which is a module base substance component. Other composition is the same as that of an working example 1.
[0062]In [ 19 is copper foil which has connected 2C with the solar battery element 2A, 2B, and 2B in series, and ] the cathode side of a solar battery element, It is connected by ****** 20 and the silver paste 21 which are formed with silver paste, and is connected to the anode side by a stainless steel board and the solder 22 for stainless steel of a solar battery element. 23 is the insulating tape made from polyimide provided by a placement part of the copper foil 19 for prevention from a short circuit.
[0063]The copper foil 19 was formed between **********, as shown in the top view 8, and a solar battery element peripheral edge part except the copper foil 19 formed EVA resin like an working example 1.
[0064]Here solar battery element peripheral edge parts other than solar battery element Mabe, Places other than a terminal area between solar battery elements which show a solar battery element peripheral edge part and a metal plate surface to form connected gently-sloping like an working example 1 at the E section of drawing 8 have formed sectional shape with which a surface of adhesives connects the adjoining solar battery element surface so that a crevice between solar battery elements might be filled thoroughly. In a terminal area by the copper foil 19, a place which is recessed shape was filled using silicon resin.
[0065]When a scratch test of a produced solar cell module was done, there is no appearance change of covering material, and degradation of an electrical property after an examination was not accepted, either.
[0066]The (working example 4), next the working example 4 of this invention are described.
[0067]In the working example 4, the pressurizer shown in drawing 10 was used instead of the vacuum laminator device used by the curing process of adhesives in the working example 2. Where application-of-pressure immobilization of the solar cell module is carried out using the pressurizer 24, it put into the heating furnace, and the solar cell module was produced like the working example 2 except having stiffened the adhesives 18.
[0068]Where the fluoro resin film 9 which is a mold releasing film is put on the acceptance surface side of a solar cell module in the working example 4, Via the silicone rubber 25, the copper plate 27 has been arranged to the rear-face side, and by the unillustrated spring member, the application-of-pressure material 26 made from aluminum was fixed again so that it might be in the pressurization state about 1 $kg/cm^2$.
[0069]As the silicone rubber 25 shows drawing 10 the F section with this welding pressure, in order to change moderately at this time, the adhesives 18 were able to be formed in desired form so that they may bury the level difference of the solar battery element 1 and the glass fiber strengthening polyester resin board 17.

[0070]When the scratch test of the produced solar cell module was done, there is no appearance change of covering material, and degradation of the electrical property after an examination was not accepted, either.
[0071]
[Effect of the Invention]As mentioned above, also in the solar battery element peripheral edge part which cannot usually form paint material in thick-film-forms voice by invention of Claims 1-6 as explained, The thick film formation by paint material is attained like other portions, and it becomes possible to provide the solar cell module which realized lamination of surface-protection material.

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## TECHNICAL FIELD

[Industrial Application]This invention relates to a solar cell module. It is related with the solar cell module which realizes lamination of the covering material of a solar battery element in details more.

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## PRIOR ART

[Description of the Prior Art]The solar cell which is an optoelectric transducer which changes sunlight into electrical energy is widely used as a power supply for household equipments, such as a calculator and a wrist watch, and attracts attention as technology utilizable as the so-called electric power for substitution of fossil fuels, such as petroleum and coal.
[0003]it is the technology using the diffusion potential generated in the pn junction part of a semiconductor, and semiconductors, such as silicon, absorb sunlight, an electron and the optical carrier of an electron hole generate a solar cell, and it carries out the drift of this optical carrier by the internal field produced with the diffusion potential of the pn junction part, and is taken out outside. As a material of a solar cell, single crystal silicon, polycrystalline silicon, an amorphous silicon, The compound semiconductor of III-V fellows, such as II-VI groups, such as an amorphous semiconductor of tetra HEDORARU systems, such as amorphous silicon germanium and amorphous SiC, CdS, $Cu_2S$, GaAs, GaAlAs, etc. are raised. The thin film solar cell using an amorphous semiconductor has the strong points, like that thickness is thin and ends and it can deposit [ that the film of a large area is producible as compared with a single crystal solar cell, and ] on arbitrary substrate materials, and promising ** is especially carried out.
[0004]By using the solar battery element of the thin film made on the existing substrate of the flexibility of stainless steel etc., an amorphous-silicon solar cell, a crystalline thin film solar cell, etc. are thin, are light, and are further made from the form of the existing flexible solar cell module, and practical use is presented with them. The surface is covered with covering material for protection from weatherability and a mechanical damage.
[0005]As a valuation basis of the covering material of a solar battery element, the "scratch test" of UL described below occurs, and if this examination can be passed, the protection ability of that covering material is considered to be sufficient thing.
[0006]If the solar cell surface is moved and there is no problem in the electrical performance of a subsequent solar cell, adding 907 g of load 8 for a testing machine with the edge 7 made of steel shown in drawing 4 by speed 152.4 mm/s when the contents of the "scratch test" are described briefly, it will be considered as success.
[0007]Incidentally, as a protective material of a solar battery element, EVA (ethylene vinyl acetate) resin and a fluoro resin film are usually used. However, in order to make EVA distribute glass fiber and for the thickness to be not less than 450 micrometers, in order to demonstrate coating protection capability with a sufficient solar battery element, and to form an about 50-micrometer fluoro resin film on it, there is a problem that a protective material will be a thick film.
[0008]On the other hand, the demand of lamination and a weight saving is stronger than that of a solar cell, and it is required that the covering material of a solar battery element should be made as thin as possible.
[0009]The methods include the method of covering a solar battery element by coating the solar battery element surface with paint material, for example. With reference to drawing 2, an example of

the amorphous-silicon solar cell module produced using the coating method of the solar battery element by this coating method is explained.

[0010]The metal electrode layer which 1 is a solar battery element and was formed by methods, such as sputtering, on the 125-micrometer-thick stainless steel board in drawing 2, The amorphous silicon semiconductor layer which formed n, i, and p layer one by one with plasma CVD method etc., and the transparent electrode layer formed with resistance heating vacuum deposition etc. are laminated in order, and it is formed. 2 is an insulating sheet material and consists of 50-micrometer-thick Nylon etc. 3 is a metal plate used as the module base substance component of a solar cell module, and a 300-micrometer-thick zinc coated steel sheet etc. are used. 4 is adhesives, adhesion with the solar battery element 1, the insulating sheet material 2 and the insulating sheet material 2, and the metal plate 3 is performed, respectively, and EVA is used, for example. Here, about the solar battery element 1, the current collection electrode which used silver paste etc. with screen printing and was formed on the transparent electrode layer is connected to an unillustrated external positive pole terminal, and the stainless steel board is connected to the unillustrated external negative pole terminal.

[0011]In order to carry out coating protection of such a solar battery element 1, a fluorocarbon resin coating is used, for example and the about 150-micrometer covering material 5 is formed in thickness. As performance as which this covering material 5 is required, can consider the dampproofing for protecting the solar battery element surface from moisture, the hard nature for passing a "scratch test", weatherability, etc., and as the material, An inorganic coating material, a fluorocarbon resin coating, acrylic silicon paints, or these things that were combined are used. Thus, the lamination of covering material is attained by constituting covering material with said paint material.

[0012]However, when a solar cell is covered only with the covering material 5, in the A section which is an end of a stainless steel board, there is a problem that it is difficult to form sufficient coated state which can pass the "scratch test" mentioned above. because, the thickness of the stainless steel board whose thickness of the covering material 5 is about 150 micrometers and which it is alike, it receives and is a base substance of a solar battery element 125 micrometers, The thickness of a solar battery element and the adhesives layer for adhesion of an insulating sheet material 100 micrometers, As the thickness of the adhesives layer for adhesion of 50 micrometers, an insulating sheet material, and a metal plate of the thickness of an insulating sheet material is 100 micrometers, the level difference B of the solar battery element surface and a metal plate is set to about 375 micrometers and it is shown in drawing 2, It is because paint material cannot flow at the time of un-hardening and about at most 30 micrometers of thickness C of the covering material 5 of the A section cannot be formed.

[0013]Therefore, in the solar cell peripheral edge part which is equivalent to the A section of drawing 2, covering will fracture easily with the edge 7 made of steel so that drawing 5 may show. That is, hard nature becomes low and a "scratch test" cannot be passed. Then, like the A section, as compared with the thickness of covering material, a level difference is large, and into the portion in which encased type voice sufficient by just covering of paint material is not formed, as shown in drawing 3, a stepped section is buried by forming the overcoat material 6, such as silicon resin, and into it, the composition which forms covering material on it can be considered.

[0014]However, in the process of providing such overcoat material, After applying overcoat material using coaters, such as a dispenser, it is necessary to stiffen overcoat material by heating or UV irradiation, and to carry out spreading hardening of the paint material on it, and the application process and curing process of overcoat material are required. For this reason, the time and the worker who manufacturing systems, such as a coater, a heating furnace, or a black light, are needed, and newly require for this process are needed, and there is a problem that the manufacturing cost of a solar cell module will rise substantially for formation of overcoat material.

[0015]

[Translation done.]

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## EFFECT OF THE INVENTION

[Effect of the Invention]As mentioned above, also in the solar battery element peripheral edge part which cannot usually form paint material in thick-film-forms voice by invention of Claims 1-6 as explained, The thick film formation by paint material is attained like other portions, and it becomes possible to provide the solar cell module which realized lamination of surface-protection material.

[Translation done.]

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## TECHNICAL PROBLEM

[Problem to be solved by the invention]In view of the above-mentioned fault, the 1st technical problem of this invention, In the solar cell module which installs a solar battery element on a module base substance component, and forms covering material in the surface, while scratch-proof nature is good and provides a thin light solar cell module, it is simplifying a process and reducing cost.

[Translation done.]

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## MEANS

[Means for solving problem]A solar cell module of this invention A module base substance component, the 1st adhesives, A solar battery element which forms a photoelectric conversion semiconductor layer on a substrate laminates one by one, and is arranged, After having been a solar cell module which it comes to cover with covering material in the surface, filling up a level difference of a periphery of said solar battery element, and said module base substance member surface with said 1st adhesives and making it gently-sloping, said covering material was formed throughout the solar cell module surface.
[0017]Other solar cell modules of this invention A module base substance component, the 1st adhesives (or the 2nd adhesives), A solar battery element which forms a photoelectric conversion semiconductor layer on an insulating sheet material, the 2nd adhesives (or the 1st adhesives), and a substrate laminates one by one, and is arranged, A solar cell module which the surface is a solar cell module which it comes to cover with covering material, and is characterized by forming said covering material throughout the solar cell module surface after filling up a level difference of a periphery of said solar battery element, and said base substance member surface with said 1st adhesives and making it gently-sloping.
[0018]As for said 1st adhesives, it is preferred to harden, where thrust is applied near [ said ] the solar battery element peripheral edge part. As for said 1st adhesives, it is desirable that they are the liquid glue which has the viscosity of 100 or more cp at the time of un-hardening, or a solid adhesive. It is desirable for the surface of said 1st adhesives to process by the coupling agent of an organic compound, or to add the coupling agent of an organic compound in said covering material.
[0019]
[Mode for carrying out the invention]Next, an embodiment of the invention is described.
[0020]Since a solar battery element peripheral edge part is filled up with the 1st adhesives and is gently-sloping as the solar cell module of this invention is shown in drawing 1, covering of the covering material of a solar cell is uniformly performed to the whole solar battery element. Therefore, it becomes possible to prevent the fracture of the covering material by a scratch test. Since a level difference is buried with the 1st adhesives, it can manufacture by the same manufacturing process as the former, and the increase in a manufacturing cost can be prevented.
[0021]The production procedures of a solar cell module of this invention are shown below.
[0022]First, arrangement adhesion of the solar battery element is carried out via the 1st adhesives on a module base substance component. Or it arranges on a module base substance component in order of the 1st adhesives, an insulating sheet material, the 2nd adhesives, and a solar battery element. Here, the 1st adhesives at least protrude and form a periphery of a solar battery element. Reverse may be sufficient as built-up sequence of the 1st adhesives and the 2nd adhesives, and it may use the same adhesives.
[0023]The 1st and 2nd adhesives use for and apply a dispenser apparatus, a die coater device, etc. to an adhesion side, or arrange sheet shaped adhesives between adherends, are heated, for example

and are made to harden them, where thrust is applied near the solar battery element peripheral edge part at least. Specifically, a method using a vacuum laminator device mentioned later is suitable one of the methods.

[0024]Next, covering material is formed in a solar cell module produced in this way. In order to realize the lamination, paint material is preferred and the formation method applies to a formation method of paint material used, respectively correspondingly, but. For example, two coats is performed several times and it is made to harden at about 120 ** so that it may become a film uniform on the module surface with air spray equipment etc. about a liquefied paint material.

[0025]When providing two or more solar battery elements, series parallel connection is made to complete before adhesion in this invention. Positive [ modular ] and the external terminal of an anode make a hole in the component used as the base substance of said module, and the method of taking out from the rear-face side is suitable for the solar cell module of this invention.

[0026]The solar cell module of this invention is produced by a process which was described above.

[0027]In the solar cell module of this invention, it is preferred at the time of hardening of said adhesives to change into the state where thrust was applied via the component with [ near the solar battery element peripheral edge part ] elasticity at least of a solar battery element and a module base substance component. Said adhesives can be formed in desired form by applying thrust via a component with elasticity. As construction material of a component with elasticity, the thing of quality of a rubber material, such as silicone rubber and neoprene rubber, is used, for example.

[0028]Although the 1st adhesives are protruded outside a solar battery element peripheral edge part and formed at least in this invention, In order that the formation range of adhesives may bury the stepped section on the surface of a solar cell module and may form adhesives with desired sectional shape, It is preferred to set distance from a and the periphery of a solar battery element to an adhesives end to b for the height from the surface of a module base substance component to the solar battery element surface, and to fill b>=1.5a, as shown in drawing 1.

[0029]As adhesives, adhesives, such as hot melt adhesive, such as elastomeric adhesives, such as adhesives of an epoxy resin system, an acrylic resin system, a polyurethane resin system, and a silicon system and a polychloroprene system, an EVA resin system, and a polyamide resin system, are suitably used by this invention, for example.

[0030]The liquid glue or the solid adhesive of 100 or more cp has [ the 1st adhesives at least ] viscosity preferred when thrust, such as atmospheric pressure, is added at the time of the curing process of adhesives at the time of un-hardening so that desired form can be formed without adhesives flowing out.

[0031]As covering material of the solar cell module of this invention, In order to realize lamination of covering material, what it was preferred that it is paint material, and a material excellent in weatherability, dampproofing, hard nature, etc. was used, for example, these paint material, such as an inorganic coating material, a fluorocarbon resin coating, and an acrylic silicon paint, combined is used suitably.

[0032]For the improvement in adhesion of the surface of said adhesives and covering material, the coupling agent of an organic compound is added in said covering material, Or it is preferred to process said adhesives surface by the coupling agent of an organic compound, and a silane coupling agent, a titanate coupling agent, etc. are raised as the material, for example.

[0033]As a module base substance component of the solar cell module of this invention, metal, the metal which performed the insulation process to the rear face, a carbon fiber, glass fiber reinforced plastic, ceramics, glass, etc. are used, for example.

[0034]As for the size of a module base substance component, it is desirable to have an outside large not less than 2 mm in all the directions in consideration of the formation range of the adhesives mentioned above from the outermost form peripheral edge part of one solar battery element or two or more solar battery elements which were connected.

[0035]As an insulating sheet material of this invention, PET (polyethylene rente phthalate), PEN

(polyethylenenaphthalate), nylon, polypropylene, a fluoro-resin, etc. are used, for example.
[0036]As for the size of an insulating sheet material, since the end disturbs and is not formed from adhesives, it is preferred that the distance c from the periphery of a solar battery element to the end is within the limits of 0 <=c<=0.5a.

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[Translation done.]

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## EXAMPLE

[Working example]Although an working example is given to below and this invention is explained more to it at details, it cannot be overemphasized that this invention is not limited to these working examples.
[0038](Working example 1) Drawing 1 is a sectional view showing the working example 1 of the solar cell module of this invention.
[0039]In the working example 1, the amorphous-silicon solar cell element 1 was formed on the 125-micrometer-thick stainless steel board. Both thickness of both performed adhesion with the solar battery element 1 and the 50-micrometer-thick insulating sheet material 2 made from a nylon film, and adhesion with the insulating sheet material 2 and the metal plate 3 (300-micrometer-thick module base substance component made from a zinc coated steel sheet) using the EVA resin 4 which is 300 micrometers. And EVA resin which is adhesives crossed throughout the peripheral edge part of the solar battery element 1, and overflowed outside the peripheral edge part, and up-and-down EVA resin was united, and formed covering material over the module surface top whole region on it.
[0040]In the working example 1, the adhesion method of the solar battery element 1, the insulating sheet material 2, and the metal plate 3 is explained below.
[0041] The EVA resin used in working example 1 is formed in a 300-micrometer-thick sheet shaped. This EVA resin sheet was greatly cut 5 mm in all the directions from the outside of the insulating sheet material 2, it carried on the metal plate 3, and the insulating sheet material 2 was carried on it. At this time, the outside of the metal plate 3 was larger in all the directions 20 mm than in the insulating sheet material 2, and the insulating sheet material 2 was produced greatly 1 mm in a similar manner than the solar battery element 1. Similarly, the EVA resin sheet was cut more greatly [ it is the same and ] 3 mm than the outside of the solar battery element 1, it carried on the insulating sheet material 2, and the solar battery element 1 was carried on it.
[0042]There are more sizes of an EVA resin sheet in proper quantity from the point of adhesive strength as a quantity of adhesives. However, it can form in the form of the request which fills above-mentioned b>=1.5a with stiffening thrust by ********** to a solar battery element peripheral edge part with the adhesives beyond this proper quantity.
[0043]Next, the field which has not performed easily-adhesive processing of corona discharge treatment etc. for the 50-micrometer-thick fluoro resin film 9 with a larger outside dimension than the metal plate 3 as a mold releasing film was turned down, and was carried. Next, this was installed in the above-mentioned vacuum laminator device 10 shown in drawing 6.
[0044]The pipe 12 is formed in the wall surface 11, and the vacuum laminator device 10 is connected to the vacuum pump in which this pipe 12 is not illustrated. The heater 14 is arranged under the copper plate 13, and it can be set as a desired temperature. 15 is flexible sheets, such as silicone rubber, and has elasticity. A vacuum pump can be used and the inside of equipment can be airtightly closed by the sealant 16. In this state, after holding the inside of equipment for 30 minutes

at 150 ** with the heater 14, it cooled to the room temperature with unillustrated cooling-water-flow equipment.
[0045][0045]. It is bridge construction anti-****** about EVA resin to have inside of equipment for 30 minutes at 150 ** in 150 **.
It is a sake, and in this state, since it would be pressed down with atmospheric pressure via the flexible sheet 15 by softening EVA resin and making the inside of equipment into a vacua, as it mentioned above, EVA resin overflows a solar battery element peripheral edge part and an insulating sheet material, and it is **.
As a result, as shown in drawing 1, the form which the surface buries the level difference of the periphery of a solar battery element and a metal plate surface, and makes gently-sloping is formed.
[0046]Although EVA resin is pressed down by atmospheric pressure as viscosity is dramatically low, and it flows at 150 ** at this time and it becomes impossible to form in the above form, The EVA resin adopted as the working example 1 had suitable viscosity (100,000 cp), was able to bury the level difference and was able to make it gently-sloping form.
[0047]Next, the process of forming covering material in the solar cell module produced as mentioned above is explained briefly.
[0048]An about 150-micrometer enveloping layer was formed by carrying out by two coats several times, and carrying out neglect hardening of the fluoro-resin system paint for 40 minutes at 120 ** all over a heating furnace with air spray equipment, throughout the surface of a solar cell module.
[0049]At this time, as mentioned above, in a solar battery element peripheral edge part, the solar cell module of the working example 1 EVA resin, Since it was formed in the form which makes gently-sloping the level difference of the periphery of a solar battery element, and a metal plate surface, in the solar battery element peripheral edge part which is a problem of a conventional example, covering material did not necessarily become thin and covering material was formed by uniform thickness.
[0050][0050]. As for the paint of this fluoro-resin system, ******** passes an above-mentioned scratch test.
Electrical property change of appearance change of covering material are a thing and according to a scratch test, photoelectric conversion efficiency, etc. is a private seal.

[0051]As mentioned above, since the produced solar cell module did not newly provide overcoat material in a solar battery element peripheral edge part as conventional technology described, it has realized lamination of the covering material of a solar cell module, without being accompanied by the process time and the cost hike concerning this process.
[0052]The (working example 2), next the working example 2 of this invention are shown in drawing 7.

[0053]The solar battery element 1 was produced like the working example 1, and used the glass fiber strengthening polyester resin board 17 which is an insulating substrate as a module base substance component. The solar battery element 1 and the glass fiber strengthening polyester resin board 17 were pasted up using the 1 liquid heat cure type adhesives (Yokohama Rubber Co., Ltd. make Y-3800) 18 of an epoxy resin system.
[0054]Since the viscosity at the time of un-hardening also had 500p, adhesives (Y-3800) were applied with the die coater device. It was larger in all the directions 2 mm than in the outside of the solar battery element 1, and applied to about 100 micrometers in thickness, and on it, still like the working example 1, the fluoro resin film 9 was carried and the solar battery element 1 was installed in the vacuum laminator device 10 at the glass fiber strengthening polyester resin board 17 top.
[0055]It determined having made this adhesive application range into the above-mentioned value based on the result obtained by experiment so that the formation range of adhesives might be formed in the form of the request which fills b>=1.5a like the working example 1.
[0056]In the working example 2, although adhesives were applied to the large glass fiber

strengthening polyester resin board 17 of an outside as adherend, Conversely, it applies to the solar battery element 1, and a part insufficient in the desired amount of adhesive applications may use a dispenser apparatus etc. for a solar battery element peripheral edge part, and may perform the method of forming separately.

[0057]Next, it installed in the vacuum laminator device 10, the inside was made into the vacua, and it held at back 120 ** for 10 minutes. The solar cell module was taken out after cooling. Although the curing conditions of adhesives (Y-3800) were 40 minutes at 120 **, the adhesives Y-3800 were formed in the form which makes gently-sloping the level difference of the periphery of a solar battery element, and a glass fiber strengthening polyester resin sheet surface like the working example 1 of the above-mentioned heating conditions.The surface of adhesives (Y-3800) was already hardened, and it was able to remove the fluoro resin film which is said mold releasing film, without breaking down the form of adhesives.

[0058]In this process, it was able to form in desired form without having pushed the viscosity of the adhesives Y-3800 on atmospheric pressure like the working example 1 by 500p and a dramatically high thing and flowing.

[0059]The process of forming a surface coating member was performed like the working example 1. In order to stiffen paint material, it put into a 120 ** heating furnace for 40 minutes first in 30 minutes and in the back. By this heating condition, adhesives (Y-3800) were able to be stiffened thoroughly.

[0060]When the scratch test of the solar cell module produced as mentioned above was done, appearance change of the covering material by examination and change of the electrical property were not accepted.

[0061]The (working example 3), next the working example 3 of this invention are described. Drawing 8 and drawing 9 are a top view of the working example 3, and a sectional view in D-D, respectively. In the working example 3, the series connection of the three solar battery elements is carried out to the metal plate 3 of one sheet which is a module base substance component. Other composition is the same as that of the working example 1.

[0062]In [ 19 is copper foil which has connected 2C with the solar battery element 2A, 2B, and 2B in series, and ] the cathode side of a solar battery element, It is connected by ****** 20 and the silver paste 21 which are formed with silver paste, and is connected to the anode side by the stainless steel board and the solder 22 for stainless steel of the solar battery element. 23 is the insulating tape made from polyimide provided by the placement part of the copper foil 19 for the prevention from a short circuit.

[0063]The copper foil 19 was formed between **********, as shown in the top view 8, and the solar battery element peripheral edge part except the copper foil 19 formed EVA resin like the working example 1.

[0064]Here solar battery element peripheral edge parts other than solar battery element Mabe, Places other than the terminal area between the solar battery elements which show a solar battery element peripheral edge part and a metal plate surface to the form connected gently-sloping like the working example 1 at the E section of drawing 8 have formed the sectional shape with which the surface of adhesives connects the adjoining solar battery element surface so that the crevice between solar battery elements might be filled thoroughly. In the terminal area by the copper foil 19, the place which is recessed shape was filled using silicon resin.

[0065]When a scratch test of a produced solar cell module was done, there is no appearance change of covering material, and degradation of an electrical property after an examination was not accepted, either.

[0066](An working example 4), next an working example 4 of this invention are described.

[0067]In an working example 4, a pressurizer shown in drawing 10 was used instead of a vacuum laminator device used by a curing process of adhesives in an working example 2. Where application-of-pressure immobilization of the solar cell module is carried out using the pressurizer 24, it put into

a heating furnace, and a solar cell module was produced like an working example 2 except having stiffened the adhesives 18.

[0068]Where the fluoro resin film 9 which is a mold releasing film is put on the acceptance surface side of a solar cell module in an working example 4, Via the silicone rubber 25, the copper plate 27 has been arranged to the rear-face side, and by an unillustrated spring member, the application-of-pressure material 26 made from aluminum was fixed again so that it might be in a pressurization state about 1 $kg/cm^2$.

[0069]As the silicone rubber 25 shows drawing 10 the F section with this welding pressure, in order to change moderately at this time, the adhesives 18 were able to be formed in desired form so that they may bury the level difference of the solar battery element 1 and the glass fiber strengthening polyester resin board 17.

[0070]When the scratch test of the produced solar cell module was done, there is no appearance change of covering material, and degradation of the electrical property after an examination was not accepted, either.

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## DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]The outline sectional view showing the solar cell module of the working example 1.
[Drawing 2]The outline sectional view showing an example of the conventional solar cell module.
[Drawing 3]The outline sectional view showing an example of the conventional solar cell module.
[Drawing 4]The schematic view showing an example of a scratch test machine.
[Drawing 5]The outline sectional view showing the state where the edge of the scratch test machine contacted with the conventional solar cell module.
[Drawing 6]The outline sectional view showing an example of a vacuum laminator device.
[Drawing 7]The outline sectional view showing the solar cell module of the working example 2.
[Drawing 8]The outline top view showing the solar cell module of the working example 3.
[Drawing 9]The outline sectional view showing the solar cell module of the working example 3.
[Drawing 10]The outline sectional view showing the making process of the solar cell module of the working example 4.
[Explanations of letters or numerals]
1 Solar battery element,
2 Insulating sheet material,
3 Module base substance component (metal plate),
4 Adhesives (EVA resin),
5 Covering material (fluoro-resin system paint),
6 Overcoat material,
7 The edge of a scratch test machine,
8 Weight,
9 Fluoro resin film,
10 Vacuum laminator device,
11 Wall,
12 Pipe,
13 Copper plate,
14 Heater,
15 Silicon rubber sheet,
16 Sealing material,
17 Fiberglass reinforced plastic,
18 Epoxy resin adhesive,
19 Copper foil,
20 Current collection electrode,
21 Silver paste,
22 Stainless steel solder,
23 Polyimide tape,

24 Pressurizer,
25 Silicone rubber,
26 Application-of-pressure material,
27 Copper plate.

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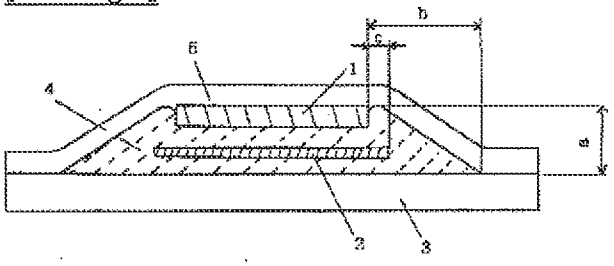
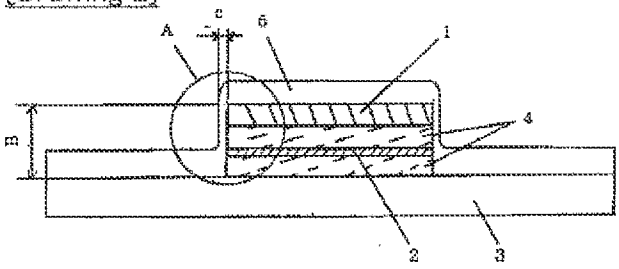
## DRAWINGS

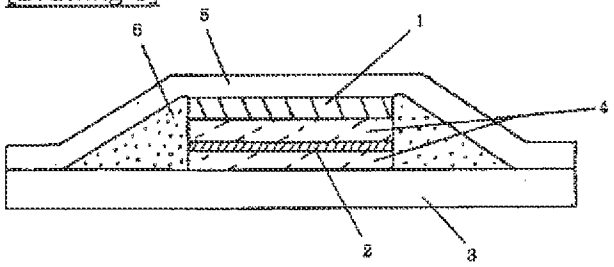
[Drawing 1]



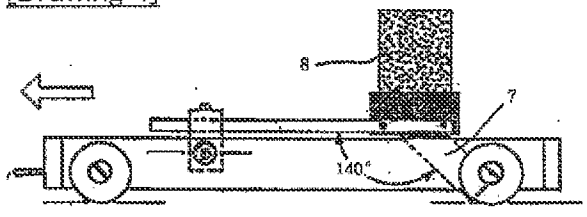

[Drawing 2]



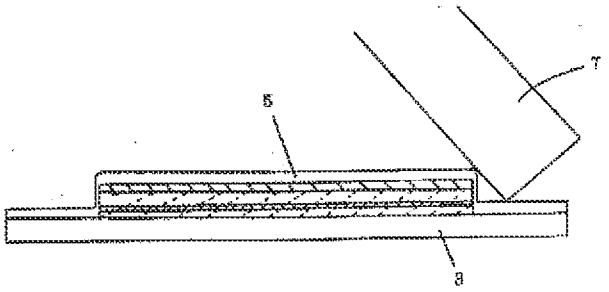

[Drawing 3]




[Drawing 4]




[Drawing 5]

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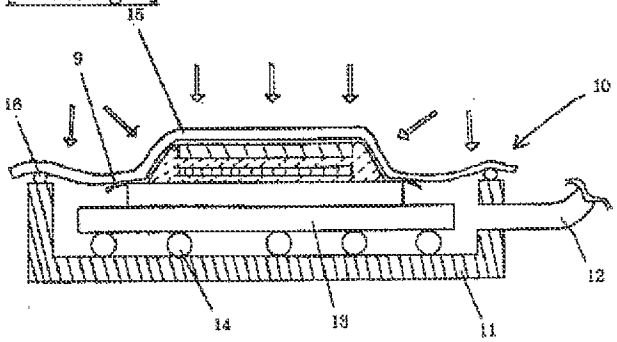


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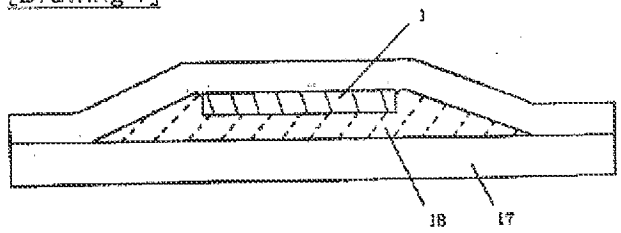


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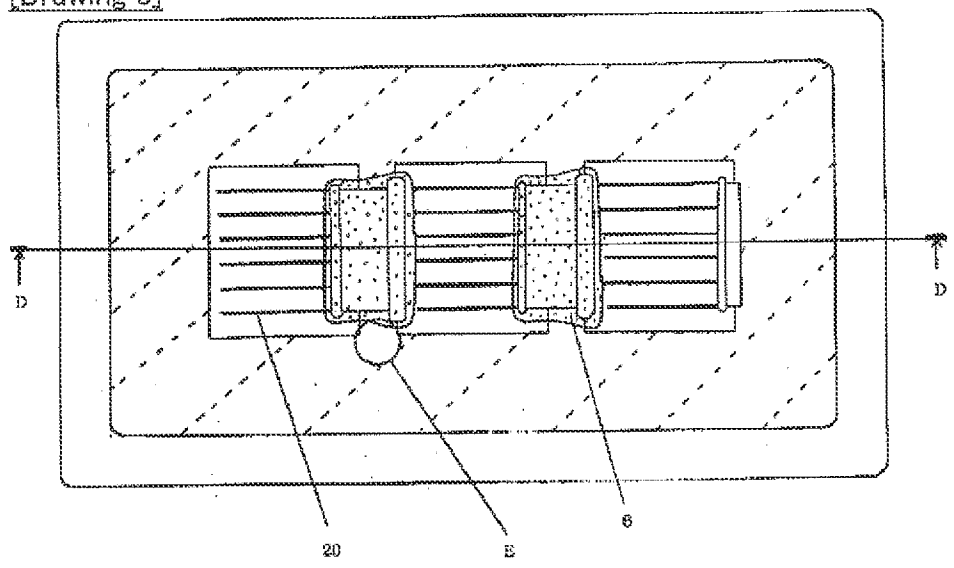


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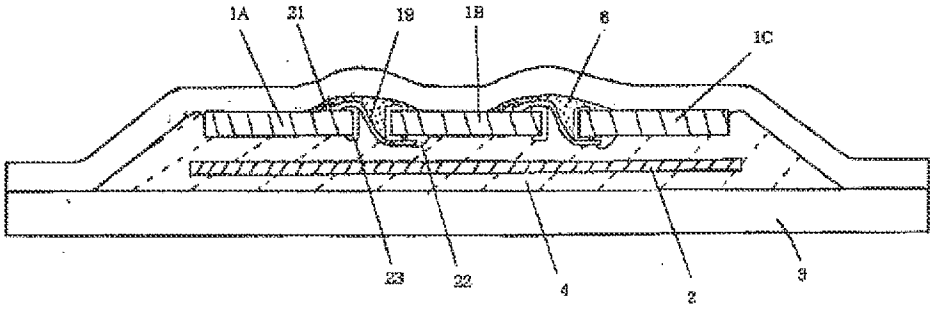
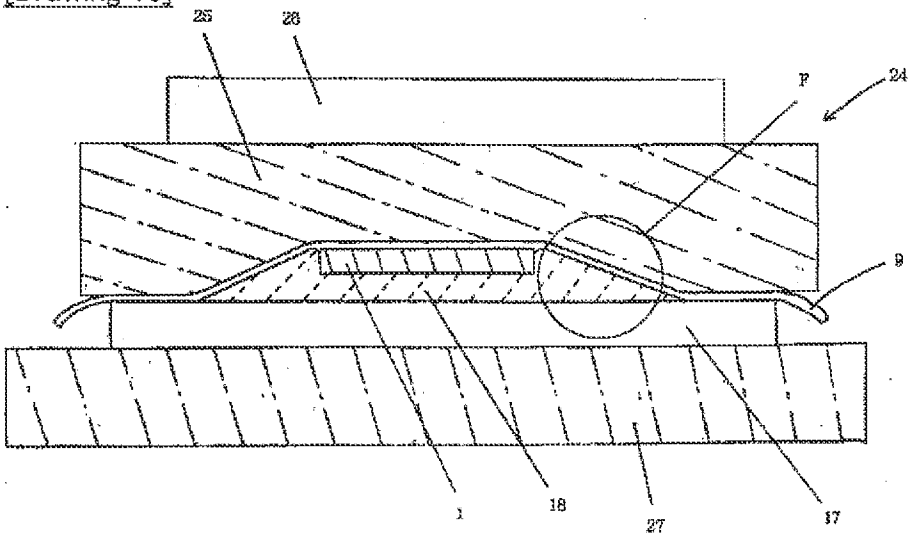



[Drawing 10]

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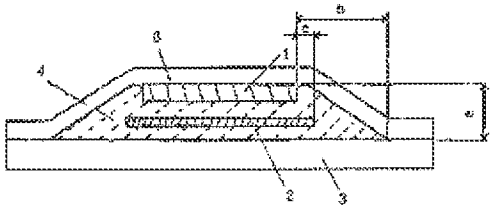
(54)【発明の名称】　太陽電池モジュール

(57)【要約】
【目的】　耐スクラッチ性が良好で、薄く軽い太陽電池モジュールを提供するを提供する。
【構成】　太陽電池モジュールは、基体部材、接着剤、太陽電池素子とが順次積層して配置され、表面が被覆材で被覆された太陽電池モジュールであって、太陽電池素子の周縁と基体部材表面との段差を接着剤で埋めてなだらかにした後、被覆材を形成した。



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【特許請求の範囲】

【請求項１】　モジュール基体部材、第１の接着剤、基板上に光電変換半導体層を形成してなる太陽電池素子とが順次積層して配置され、表面が被覆材で被覆されてなる太陽電池モジュールであって、前記太陽電池素子の周縁と前記モジュール基体部材表面との段差を前記第１の接着剤で埋めてなだらかにした後、太陽電池モジュール表面全域に前記被覆材を形成したことを特徴とする太陽電池モジュール。

【請求項２】　モジュール基体部材、第１の接着剤（または第２の接着剤）、絶縁シート材、第２の接着剤（または第１の接着剤）、基板上に光電変換半導体層を形成してなる太陽電池素子とが順次積層して配置し、表面が被覆材で被覆されてなる太陽電池モジュールであって、前記太陽電池素子の周縁と前記基体部材表面との段差を前記第１の接着剤で埋めてなだらかにした後、太陽電池モジュール表面全域に前記被覆材を形成したことを特徴とする太陽電池モジュール。

【請求項３】　前記第１の接着剤は、前記太陽電池素子周縁部近傍に押圧力を加えた状態で硬化したことを特徴とする請求項１または２に記載の太陽電池モジュール。

【請求項４】　前記第１の接着剤は、未硬化時において１００ｃｐ以上の粘度を有する液状接着剤、または線形状接着剤であることを特徴とする請求項１～３のいずれか１項に記載の太陽電池モジュール。

【請求項５】　前記第１の接着剤の表面は、有機化合物のカップリング剤で処理したことを特徴とする請求項１～４のいずれか１項に記載の太陽電池モジュール。

【請求項６】　前記被覆材中に有機化合物のカップリング剤を添加したことを特徴とする請求項１～５のいずれか１項に記載の太陽電池モジュール。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明は、太陽電池モジュールに係わる。より詳細には、太陽電池素子の被覆材の薄層化を実現する太陽電池モジュールに関する。

【０００２】

【従来の技術】太陽光を電気エネルギーに変換する光電変換素子である太陽電池は、電卓、腕時計など民生機器用の電源として広く使用されており、また、石油、石炭などのいわゆる化石燃料の代替用電力として実用化可能な技術として注目されている。

【０００３】太陽電池は半導体のｐｎ接合部に発生する拡散電位を利用した技術であり、シリコンなどの半導体が太陽光を吸収し、電子と正孔の光キャリヤーが生成し、該光キャリヤーをｐｎ接合部の拡散電位により生じた内部電界でドリフトさせ、外部に取り出すものである。太陽電池の材料としては、単結晶シリコン、多結晶シリコン、アモルファスシリコン、アモルファスシリコンゲルマニウム、アモルファスＣｕＩＳなどのアトラヘドラル系のアモルファス半導体や、ＣｄＳ，Ｃｕ２ＳなどのＩＩ－ＶＩ族やＧａＡｓ，ＧａＡｌＡｓなどのＩＩＩ－Ｖ族の化合物半導体等があげられる。とりわけ、アモルファス半導体を用いた薄膜太陽電池は、単結晶太陽電池に比較して大面積の膜が作製できることや、膜厚が薄くて済むこと、任意の基板材料に堆積できることなどの長所があり有望視されている。

【０００４】アモルファスシリコン太陽電池、結晶薄膜太陽電池等は、ステンレス等の可曲性のある基板上に作られた薄膜の太陽電池素子を用いることにより、薄くて軽く、さらに可曲性のある太陽電池モジュールの形で作られ、実用に供されている。また、耐候性、機械的損傷からの保護のため、被覆材で表面を被覆する。

【０００５】太陽電池素子の被覆材の評価基準としては、以下に述べるＵＬ規格の「引っかき試験」があり、この試験に合格することができれば、その被覆材の保護能力は十分なものと考えられている。

【０００６】「引っかき試験」の内容を簡単に述べると、図４に示す鋼鉄製の刃７を持った試験機を速度１５２．４ｍｍ／ｓで、９０７ｇの荷重８を加えながら太陽電池表面を動かし、その後の太陽電池の電気的性能に問題がなければ、合格とされる。

【０００７】ちなみに、太陽電池素子の保護材料としては、通常ＥＶＡ（エチレンビニルアセテート）樹脂及びフッ素樹脂フィルムが用いられる。しかし、太陽電池素子の十分な被覆保護能力を発揮するために、ＥＶＡにガラス繊維を分散させて、その厚みを４５０μｍ以上とし、その上に５０μｍ程度のフッ素樹脂フィルムを形成するため、保護材料が厚膜となってしまうという問題がある。

【０００８】一方、太陽電池のより薄層化、軽量化の要求は強く、太陽電池素子の被覆材料は、できるだけ薄くすることが要求されている。

【０００９】その方法として、例えば塗料材料を太陽電池素子表面にコーティングすることにより、太陽電池素子の被覆を行う方法がある。図２を参照して、このコーティング法による太陽電池素子の被覆方法を用いて作製したアモルファスシリコン太陽電池モジュールの一例を説明する。

【００１０】図２において、１は太陽電池素子であり、厚さ１２５μｍのステンレス基板上に、スパッタリング等の方法により形成した金属電極層と、プラズマＣＶＤ法等によりｎ，ｉ，ｐ層を順次形成したアモルファスシリコン半導体層と、抵抗加熱蒸着法等により形成した透明電極層とを順に積層して形成されている。２は絶縁シート材であり、厚さ５０μｍのナイロン樹脂等からなる。３は、太陽電池モジュールのモジュール基体部材となる金属板であって、厚さ３００μｍの亜鉛塗鉄鋼板等が用いられる。４は接着剤であり、それぞれ太陽電池素子１と絶縁シート材２、絶縁シート材２と金属板３との

接着を行うもので、例えばＥＶＡが用いられる。ここで、太陽電池素子１については、透明電極層上にスクリーン印刷法により銀ペースト等を用い形成された集電電極が、不図示の外部正極端子に接続され、またステンレス基板が不図示の外部負極端子に接続されている。

【００１１】このような太陽電池素子１を被覆保護するために、例えばフッ素樹脂塗料を用い厚さは１５０μｍ程度の被覆材５が設けられている。該被覆材５の要求される性能としては、太陽電池素子表面を防湿するための防湿性と、「引っかき試験」に合格するための緻密性、耐候性などが考えられ、その材料としては、無機塗料、フッ素樹脂塗料、アクリルシリコン塗料、またはこれらの組み合わせたものが用いられる。このように前記塗料材料により被覆材を構成することにより、被覆材の薄層化が達成される。

【００１２】しかし、被覆材５だけで太陽電池の被覆を行うと、ステンレス基板の端部であるＡ部において、上述した「引っかき試験」に合格できるだけの十分な被覆状態を形成することは難しいという問題がある。なぜならば、被覆材５の厚みは１５０μｍ程度であるに対して、太陽電池素子の基体であるステンレス基板の厚みは１２５μｍ、太陽電池素子と絶縁シート材の接着のための接着剤層の厚みが１００μｍ、絶縁シート材の厚みが５０μｍ、絶縁シート材と金属板の接着のための接着剤層の厚みが１００μｍであり、太陽電池素子表面と金属板の段差Ｂは３７５μｍ程度にもなり、図２に示すように、塗料材料が未硬化時に流れてしまい、Ａ部の被覆材５の膜厚Ｃはせいぜい３０μｍ程度しか設けることができないからである。

【００１３】したがって、図５から分かるように、鋼鉄製の刃７により、図２のＡ部にあたる太陽電池周縁部においては、被覆が容易に破断してしまう。すなわち、緻密性が低くなり、「引っかき試験」に合格することはできない。そこで、Ａ部のように、被覆材料の膜厚に比して段差が大きく、塗料材料の被覆のみでは十分な被覆形態が形成されない部分には、図３に示すようにシリコン樹脂等のオーバーコート材６を設けることにより、段差部を埋め、その上に被覆材を設ける構成が考えられる。

【００１４】しかし、このようなオーバーコート材を設ける工程においては、オーバーコート材をディスペンサー等の塗布装置を用いて塗布した後に、オーバーコート材を加熱あるいは紫外線照射等により硬化させて、その上に塗料材料を塗布硬化する必要があり、オーバーコート材の塗布工程及び硬化工程が必要である。このため、新たに、塗布装置、加熱炉あるいは紫外線照射装置等の生産装置が必要となり、また、該工程に要する時間及び作業者が必要となり、オーバーコート材の形成のために、太陽電池モジュールの製造コストが大幅に上昇してしまうという問題がある。

【００１５】



【発明が解決しようとする課題】上記欠点に鑑み、本発明の第１の技術的課題は、太陽電池素子をモジュール基体部材上に設置し、表面に被覆材を形成する太陽電池モジュールにおいて、耐スクラッチ性が良好で、薄く軽い太陽電池モジュールを提供するとともに、工程を簡略化し、コストを削減することである。

【００１６】

【課題を解決するための手段】本発明の太陽電池モジュールは、モジュール基体部材、第１の接着剤、基板上に光電変換半導体層を形成してなる太陽電池素子とが順次積層して配置され、表面を被覆材で被覆されてなる太陽電池モジュールであって、前記太陽電池素子の周縁と前記モジュール基体部材表面との段差を前記第１の接着剤で埋めてなだらかにした後、太陽電池モジュール表面全域に前記被覆材を形成したことを特徴とする。

【００１７】また、本発明の他の太陽電池モジュールは、モジュール基体部材、第１の接着剤（または第２の接着剤）、絶縁シート材、第２の接着剤（または第１の接着剤）、基板上に光電変換半導体層を形成してなる太陽電池素子とが順次積層して配置され、表面が被覆材で被覆されてなる太陽電池モジュールであって、前記太陽電池素子の周縁と前記基体部材表面との段差を前記第１の接着剤で埋めてなだらかにした後、太陽電池モジュール表面全域に前記被覆材を形成したことを特徴とする太陽電池モジュール。

【００１８】前記第１の接着剤は、前記太陽電池素子周縁部近傍に押圧力を加えた状態で硬化するのが好ましい。また、前記第１の接着剤は、未硬化時において１００ｃｐ以上の粘度を有する液状接着剤、または固形状接着剤であることが望ましい。さらに、前記第１の接着剤の表面が、有機化合物のカップリング剤で処理するかまたは／及び前記被覆材中に有機化合物のカップリング剤を添加するのが望ましい。

【００１９】

【発明の実施の形態】次に、本発明の実施の形態について説明する。

【００２０】本発明の太陽電池モジュールは、図１に示すように、太陽電池素子周縁部が第１の接着剤で埋められなだらかになっているため、太陽電池の被覆材の被覆が太陽電池素子全体に均一に行われる。したがって、引っかき試験による被覆材の破断を防ぐことが可能となる。さらに、段差を第１の接着剤により埋めるため、従来と同じ製造工程で製造でき、製造コストの増加を防ぐことができる。

【００２１】本発明の太陽電池モジュールの作製手順を以下に示す。

【００２２】まず、モジュール基体部材上に、第１の接着剤を介し太陽電池素子を配置接着する。あるいは、モジュール基体部材上に、第１の接着剤、絶縁シート材、第２の接着剤、太陽電池素子の順に配置する。ここで、

少なくとも第１の接着剤は太陽電池素子の周縁をはみ出して形成する。また、第１の接着剤と第２の接着剤の積層順序は逆でも良いし、また同一の接着剤を用いても良い。

【００２３】第１及び第２の接着剤は、接着面にディスペンサー装置、ダイコーター装置等を用いて塗布し、もしくはシート状の接着剤を被着体の間に配置し、少なくとも太陽電池素子周縁部近傍に押圧力を加えた状態で、例えば加熱して硬化させるものである。具体的には、後述する真空ラミネーター装置を用いた方法は適した方法の一つである。

【００２４】次に、このように作製された太陽電池モジュールに被覆材を形成する。その薄層化を実現するために、塗料材料が好ましく、その形成方法は、それぞれ使用する塗料材料の形成方法に準じるものであるが、例えば、液状の塗料材料をエアスプレー装置等により、モジュール表面に均一な膜となるように、数回重ね塗りを行い、１２０℃程度で硬化させる。

【００２５】本発明において、複数の太陽電池素子を設ける場合には、接着前に直並列接続を完了させておく。また、モジュールの正、負極の外部端子は前記モジュールの基体となる部材に穴をあけ、裏面側より取り出す方法が本発明の太陽電池モジュールに適している。

【００２６】以上述べたような工程により、本発明の太陽電池モジュールを作製する。

【００２７】本発明の太陽電池モジュールにおいて、前記接着剤の硬化時に、太陽電池素子及びモジュール基体部材の、少なくとも太陽電池素子周縁部近傍に、弾性を有した部材を介して押圧力を加えた状態とすることが好ましい。弾性を有した部材を介して押圧力を加えることにより、前記接着剤を所望の形状に形成することができる。弾性を有した部材の材質としては、例えばシリコンゴム、ネオプレン・ゴム等のゴム材質のものが用いられる。

【００２８】また、本発明において、少なくとも第１の接着剤を太陽電池素子周縁部より外側にはみ出して形成するが、接着剤の形成範囲は太陽電池モジュール表面の段差部を埋め、所望の断面形状を有した接着剤を形成するために、図１に示すように、モジュール基体部材の表面から太陽電池素子表面までの高さをａ、太陽電池素子周縁から接着剤端部までの距離をｂとして、ｂ≧１．５ａを満たすことが好ましい。

【００２９】本発明で接着剤としては、例えばエポキシ樹脂系、アクリル樹脂系、ポリウレタン樹脂系、シリコン系の接着剤、ポリクロロプレン系などのゴム系接着剤、ＥＶＡ樹脂系、ポリアミド樹脂系などのホットメルト接着剤等の接着剤が好適に用いられる。

【００３０】接着剤の硬化工程時に大気圧等の押圧力が加わったときに、接着剤が流れ出すことなく所望の形状が形成できるように、少なくとも第１の接着剤は未硬化時に、粘度が１００ｃｐ以上の液状接着剤もしくは固形状接着剤が好ましい。

【００３１】本発明の太陽電池モジュールの被覆材としては、被覆材の薄層化を実現するために、塗料材料であることが好ましく、耐候性、防湿性、硬質性等が優れた材料が用いられ、例えば無機塗料、フッ素樹脂塗料、アクリルシリコン塗料など、また、これら塗料材料の組み合わせたものが好適に用いられる。

【００３２】前記接着剤の表面と被覆材料の密着性向上のために、前記被覆材中に有機化合物のカップリング剤を添加、あるいは前記接着剤表面を有機化合物のカップリング剤で処理することが好ましく、その材料としては、例えばシランカップリング剤、チタネートカップリング剤等があげられる。

【００３３】本発明の太陽電池モジュールのモジュール基体部材としては、例えば金属、裏面に絶縁処理を施した金属、カーボンファイバー、ガラスファイバー強化プラスチック、セラミック、ガラスなどが用いられる。

【００３４】また、モジュール基体部材の大きさは、上述した接着剤の形成範囲を考慮し、一つの太陽電池素子もしくは接続された複数の太陽電池素子の最外形周縁部より全方向に２ｍｍ以上大きい外形を持つことが望ましい。

【００３５】本発明の絶縁シート材としては、例えばＰＥＴ（ポリエチレンテフタレート）、ＰＥＮ（ポリエチレンナフタレート）、ナイロン、ポリプロピレン、フッ素樹脂等が用いられる。

【００３６】また、絶縁シート材の大きさは、その端部が接着剤からはみだして形成されないために、太陽電池素子周縁からその端部までの距離ｃが０≦ｃ≦０．５ａの範囲内であることが好ましい。

【００３７】

【実施例】以下に、実施例を挙げて本発明をより詳細に説明するが、本発明がこれら実施例に限定されないことはいうまでもない。

【００３８】（実施例１）図１は、本発明の太陽電池モジュールの実施例１を示す断面図である。

【００３９】実施例１においては、厚さ１２５μｍのステンレス基板上に、アモルファスシリコン太陽電池素子１を形成した。太陽電池素子１と厚さ５０μｍのナイロンフィルム製の絶縁シート材２との接着、及び絶縁シート材２と金属板３（厚さ３００μｍの塗鉛塗装鋼板製のモジュール基体部材）との接着を、ともに厚さがともに３００μｍのＥＶＡ樹脂４を用いて行った。そして、接着剤であるＥＶＡ樹脂が太陽電池素子１の周縁部全域にわたって、周縁部より外側にはみ出して上下のＥＶＡ樹脂は一体となり、その上にモジュール表面上全域にわたって被覆材を形成した。

【００４０】実施例１において、太陽電池素子１、絶縁シート材２、金属板３の接着方法を以下に説明する。

【００４１】実施例１で用いるＥＶＡ樹脂は、厚さ３００μｍのシート状に形成されたものである。このＥＶＡ樹脂シートを絶縁シート材２の外形より全方向に５ｍｍ大きく切りとり、金属板３の上に載せ、その上に絶縁シート材２を載せた。このとき、金属板３の外形は絶縁シート材２より全方向に２０ｍｍ大きく、絶縁シート材２は太陽電池素子１より同様に１ｍｍ大きく作製した。また同様に、ＥＶＡ樹脂シートを太陽電池素子１の外形より同じく３ｍｍ大きく切りとり、絶縁シート材２の上に載せ、その上に、太陽電池素子１を載せた。

【００４２】ＥＶＡ樹脂シートの大きさは、接着剤の量として接着力の点からは、適正量より多いものである。しかしこの適正量を越えた接着剤により、太陽電池素子周縁部に押圧力に加わえた状態で硬化させることで、上述のｂ≧１．５ａを満たす所望の形状に形成することができる。

【００４３】次に、離型フィルムとして金属板３より外形寸法の大きい、厚さ５０μｍのフッ素樹脂フィルム９をコロナ放電処理等の易接着処理を施していない面を下側にして載せた。次にこれを、図６に示す上述の真空ラミネーター装置１０に設置した。

【００４４】真空ラミネーター装置１０は盤面１１に管１２が設けられ、この管１２が不図示の真空ポンプに接続されている。また、鋼板１３の下にはヒーター１４が配置され、所望の温度に設定することができる。１５はシリコンゴム等の可とう性シートであり、弾性を有している。真空ポンプを働かせ、シール材１６により、装置内を気密に封止することができる。この状態で、ヒーター１４により、装置内を１５０℃に３０分間保持したのち、不図示の冷却水循環装置により室温まで冷却した。

【００４５】装置内を１５０℃で３０分間保持するのは、ＥＶＡ樹脂を１５０℃において架橋反応させるためであり、またこの状態ではＥＶＡ樹脂は軟化し、装置内を真空状態にすることにより、可とう性シート１５を介して大気圧で押さえつけられることになるので、上述したように太陽電池素子周縁部及び絶縁シート材からＥＶＡ樹脂がはみ出すこととなる。その結果、図１に示すように、その表層が太陽電池素子周縁と金属板表面との段差を埋めてなだらかにする形状が形成される。

【００４６】このとき、もしＥＶＡ樹脂が１５０℃で非常に粘度の低いものであると、大気圧に押さえつけられ流れてしまい、上記のような形状に形成できなくなるが、実施例１に採用したＥＶＡ樹脂は適当な粘性（１００、０００　ｃｐ）を持っており、段差を埋めなだらかな形状にすることができた。

【００４７】次に、以上のように作製された太陽電池モジュールに被覆材を形成する工程について簡単に説明する。

【００４８】太陽電池モジュールの表面全域に、フッ素樹脂系塗料をエアスプレー装置により数回重ね塗り、加熱炉中に１２０℃で４０分間放置硬化させることにより、１５０μｍ程度の被覆層を形成した。



【００４９】このとき、実施例１の太陽電池モジュールは上述したように、太陽電池素子周縁部においてＥＶＡ樹脂は、太陽電池素子周縁と金属板表面との段差をなだらかにする形状に形成されているので、従来例の問題点である太陽電池素子周縁部において、被覆材が薄くなるということはなく、被覆材は均一の膜厚で形成された。

【００５０】このフッ素樹脂系の塗料による被覆材は、上述の引っかき試験に合格するのに十分なものであり、引っかき試験による被覆材の外観変化及び光電変換効率等の電気特性変化は認められなかった。

【００５１】以上のように、作製された太陽電池モジュールは、従来技術で述べたように太陽電池素子周縁部にオーバーコート材を新たに設けることがないので、この工程にかかる工程時間及びコストアップを伴わずに、太陽電池モジュールの被覆材の薄層化が実現できた。

【００５２】（実施例２）次に、本発明の実施例２を図７に示す。

【００５３】太陽電池素子１は実施例１と同様に作製されたものであり、モジュール基体部材として絶縁基板であるガラス繊維強化ポリエステル樹脂板１７を用いた。太陽電池素子１とガラス繊維強化ポリエステル樹脂板１７は、エポキシ樹脂系の１液加熱硬化タイプの接着剤（横浜ゴム（株）製Ｙ－３８００）１８を用いて接着した。

【００５４】接着剤（Ｙ－３８００）は未硬化時の粘度は５００ｐもあるので、ダイコーター装置により塗布した。ガラス繊維強化ポリエステル樹脂板１７上に太陽電池素子１の外形より全方向に２ｍｍ大きく、厚さ１００μｍ程度に塗布し、その上に太陽電池素子１を、さらに実施例１と同様に、フッ素樹脂フィルム９を載せ、真空ラミネーター装置１０内に設置した。

【００５５】この接着剤塗布範囲を上記の値としたのは、実施例１と同様に、接着剤の形成範囲がｂ≧１．５ａを満たす所望の形状に形成されるように、実験により得られた結果を基に決定した。

【００５６】また実施例２においては、接着体として外形の大きいガラス繊維強化ポリエステル樹脂板１７に接着剤の塗布を行ったが、直に太陽電池素子１に塗布を行い、所望の接着剤塗布量に足りない分は、太陽電池素子周縁部にディスペンサー装置等を用い、別途、設ける方法を行っても良い。

【００５７】次に、真空ラミネーター装置１０に設置し、内部を真空状態にして後１２０℃で１０分保持した。冷却後、太陽電池モジュールを取り出した。接着剤（Ｙ－３８００）の硬化条件は１２０℃で４０分であるが、上記加熱条件により、接着剤Ｙ－３８００は実施例１と同様に太陽電池素子周縁とガラス繊維強化ポリエステル樹脂板表面との段差をなだらかにする形状に形成さ

れた。また、接着剤（Ｙ－３８００）の表層は既に硬化しており、接着剤の形状を崩すことなく、前記離型フィルムであるフッ素樹脂フィルムを剥すことができた。

【００５８】この工程において、接着剤Ｙ－３８００の粘度が５００ｐと非常に高いことにより、実施例１と同様に、大気圧に押されて流れてしまわないで、所望の形状に形成することができた。

【００５９】表面被覆部材を形成する工程は実施例１と同様に行った。塗料材料を硬化させるために最初に３０分間、後で４０分間１２０℃の加熱炉に入れた。この加熱条件により、接着剤（Ｙ－３８００）を完全に硬化させることができた。

【００６０】以上のように作製した太陽電池モジュールの引っかき試験を行ったところ、試験による被覆材の外観変化、及び電気特性の変化は認められなかった。

【００６１】（実施例３）次に、本発明の実施例３について説明する。図８及び図９はそれぞれ実施例３の平面図及びＤ－Ｄにおける断面図である。実施例３においては、モジュール基体部材である１枚の金属板３に対して３個の太陽電池素子が直列接続されて設けられている。他の構成は実施例１と同様である。

【００６２】１９は太陽電池素子２Ａと２Ｂ及び２Ｂと２Ｃを直列に接続している銅箔であり、太陽電池素子の正極側においては、銀ペーストによって形成される集電電２０と銀ペースト２１によって接続され、負極側においては、太陽電池素子のステンレス基板とステンレス用ハンダ２２によって接続されている。２３は銅箔１９の配置部で短絡防止のために設けたポリイミド製絶縁テープである。

【００６３】銅箔１９は平面図８に示すように太電池素子間に設けられ、銅箔１９を除く太陽電池素子周縁部は、実施例１と同様にＥＶＡ樹脂を形成した。

【００６４】ここで、太陽電池素子間部以外の太陽電池素子周縁部は、実施例１と同様に、太陽電池素子周縁部と金属板表面をなだらかにつなぐ形状に、図８のＥ部に示す太陽電池素子間における接続部以外のところは、太陽電池素子間の凹部を完全に埋めるように、接着剤の表層が隣接の太陽電池素子表面をつなぐ断面形状を形成できた。また、銅箔１９による接続部において、凹部状になっているところは、シリコン樹脂を用いて埋めた。

【００６５】作製した太陽電池モジュールの引っかき試験を行ったところ、被覆材の外観変化はなく、また試験後の電気特性の劣化も認められなかった。

【００６６】（実施例４）次に、本発明の実施例４について説明する。

【００６７】実施例４では、実施例２において接着剤の硬化工程で用いた真空ラミネーター装置の代わりに、図１０に示す加圧装置を用いた。加圧装置２４を用い太陽電池モジュールを加圧固定させた状態で加熱炉に入れ、接着剤１８を硬化させた以外は実施例２と同様にして太陽電池モジュールを作製した。

【００６８】実施例４では、太陽電池モジュールの受光面側に離型フィルムであるフッ素樹脂フィルム９を載せた状態で、シリコンゴム２５を介してアルミニウム製の加圧材２６を、また、裏面側には鋼板２７を配置し、不図示のバネ部材により、１ｋｇ／ｃｍ$^2$程度の加圧状態となるように固定した。

【００６９】このとき、この加圧力によりシリコンゴム２５が、Ｆ部において図１０に示すように適度に変形するために、接着剤１８は太陽電池素子１とガラス繊維強化ポリエステル樹脂板１７の段差を埋めるべく所望の形状に形成することができた。

【００７０】作製した太陽電池モジュールの引っかき試験を行ったところ、被覆材の外観変化はなく、また試験後の電気特性の劣化も認められなかった。

【００７１】

【発明の効果】以上、説明したように、請求項１～６の発明により、通常は塗料材料を薄膜状態に形成することのできない太陽電池素子周縁部においても、他の部分と同様に塗料材料による厚膜形成が可能となり、表面保護材の薄層化を実現した太陽電池モジュールを提供することが可能となる。

【図面の簡単な説明】

【図１】実施例１の太陽電池モジュールを示す概略断面図。

【図２】従来の太陽電池モジュールの一例を示す概略断面図。

【図３】従来の太陽電池モジュールの一例を示す概略断面図。

【図４】引っかき試験機の一例を示す概略図。

【図５】従来の太陽電池モジュールで引っかき試験機の刃が当接した状態を示す概略断面図。

【図６】真空ラミネーター装置の一例を示す概略断面図。

【図７】実施例２の太陽電池モジュールを示す概略断面図。

【図８】実施例３の太陽電池モジュールを示す概略平面図。

【図９】実施例３の太陽電池モジュールを示す概略断面図。

【図１０】実施例４の太陽電池モジュールの作製工程を示す概略断面図。

【符号の説明】

１　太陽電池素子、
２　絶縁シート材、
３　モジュール基体部材（金属板）、
４　接着剤（ＥＶＡ樹脂）、
５　被覆材（フッ素樹脂系塗料）、
６　オーバーコート材、
７　引っかき試験機の刃、

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8　おもり、
9　フッ素樹脂フィルム、
10　真空ラミネーター装置、
11　内壁、
12　管、
13　銅板、
14　ヒーター、
15　シリコンゴムシート、
16　シーリング材、
17　ガラス繊維強化プラスチック、

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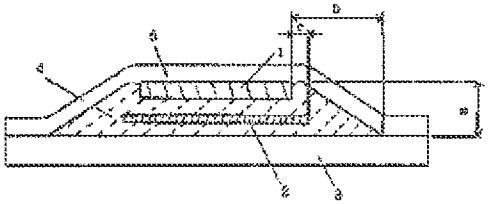
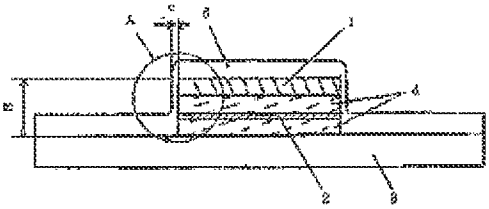
＊18　エポキシ樹脂系接着剤、
19　銅箔、
20　単電電極、
21　銀ペースト、
22　ステンレスはんだ、
23　ポリイミドテープ、
24　加圧装置、
25　シリコンゴム、
26　加圧材、
＊10　27　銅板。

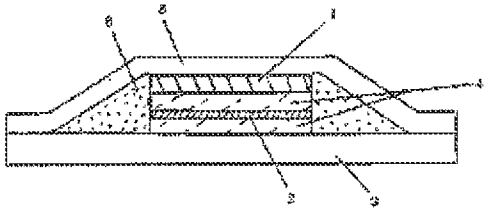
【図１】



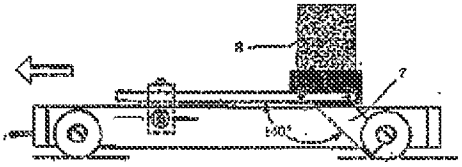
【図２】



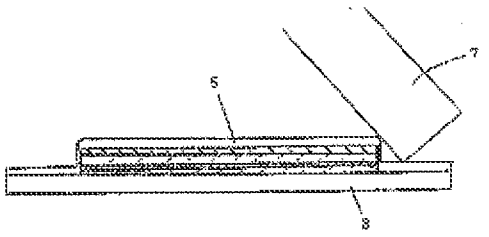
【図３】



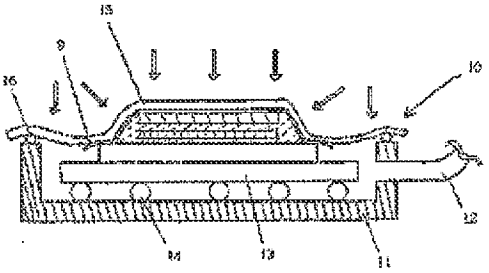
【図４】



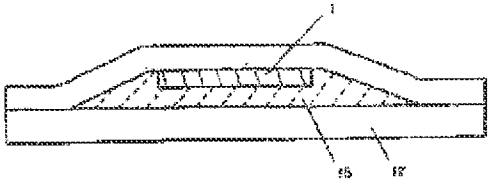
【図５】



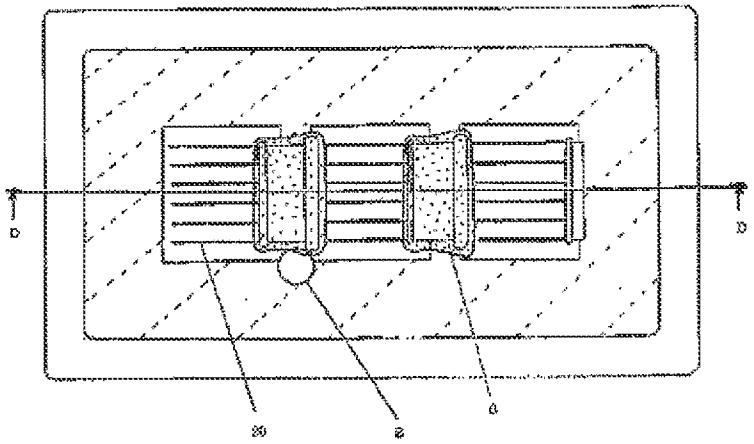
【図６】



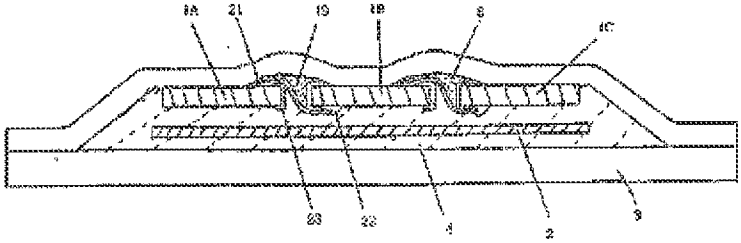
【図７】



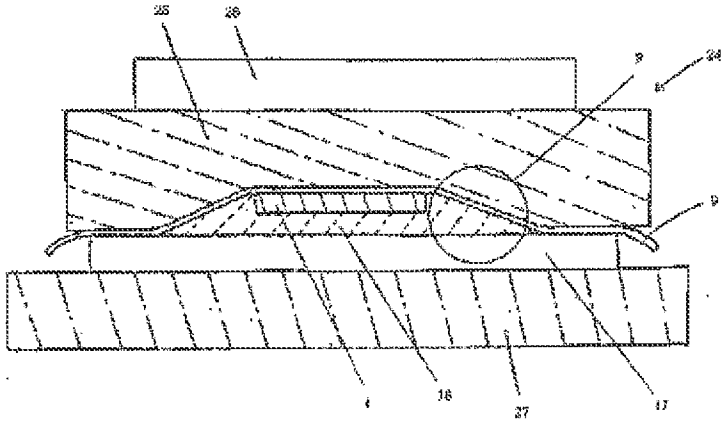
【図8】




【図9】




【図10】



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